

**WHAT IS CLAIMED IS:**

1. A semiconductor device manufacturing method, comprising the steps of:

forming a trench by etching a silicon substrate;

5 forming a silicon nitride film along an inner wall of said trench; and

converting a part of said silicon nitride film to a non-silicon-nitride type insulator film.

10 2. A semiconductor device manufacturing method, comprising the steps of:

forming a trench by etching a silicon substrate;

forming a silicon nitride film along an inner wall of said trench;

15 forming a first embedded insulator film inside said trench, said first embedded insulator film having a film thickness so as not to completely fill said trench;

converting a part of said silicon nitride film into a non-silicon-nitride type insulator film, said part being  
20 exposed from said first embedded insulator film; and

forming a second embedded insulator film on said first embedded insulator film and filling said trench with said first and second embedded insulator films.

25 3. The semiconductor device manufacturing method according to claim 2, further comprising, prior to the step of forming said silicon nitride film along said inner wall of said trench, a step of oxidizing said inner wall of said trench to form a silicon oxide film.

4. The semiconductor device manufacturing method according to claim 2, wherein

5       said non-silicon-nitride type insulator film is positioned lower than a channel depth of a MOS transistor to be formed on said silicon substrate.

5. The semiconductor device manufacturing method according to claim 2, wherein

10       said part of said silicon nitride film is converted into said non-silicon-nitride type insulator film by using an ISSG oxidation method.

15 6. The semiconductor device manufacturing method according to claim 2, wherein

20       the step of converting said part of said silicon nitride film into said non-silicon-nitride type insulator film and the step of forming said second embedded insulator film on said first embedded insulator film are successively performed in a same apparatus.

7. The semiconductor device manufacturing method according to claim 2, wherein

25       said first embedded insulator film is formed by either one of a pyrolytic CVD method using  $O_3$ -TEOS as a source gas and an HDP-CVD method.

8. The semiconductor device manufacturing method according to claim 2, wherein

at least one of said first and second embedded insulator films is formed by using a coating method.

9. The semiconductor device manufacturing method according  
5 to claim 8, wherein

said insulator film formed by the coating method is a polysilazane-type SOG film or an SOG film including porous silica.

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